Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Learner Registration Number

Pearson BTEC Level 3 Nationals Certificate, Extended Certificate, Foundation Diploma, Diploma, Extended Diploma

Time 40 minutes

Paper reference **31617H/1P**

Applied Science/Forensic and Criminal Investigation

UNIT 1: Principles and Applications of Science I
Physics
SECTION C: WAVES IN COMMUNICATION

You must have:
A calculator and a ruler.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The exam comprises three papers worth 30 marks each:
  - Section A: Structures and Functions of Cells and Tissues (Biology)
  - Section B: Periodicity and Properties of Elements (Chemistry)
  - Section C: Waves in Communication (Physics).
- The total mark for this exam is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- The formulae sheet can be found at the back of this paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Figure 1 shows the displacement of a surface water wave with time.

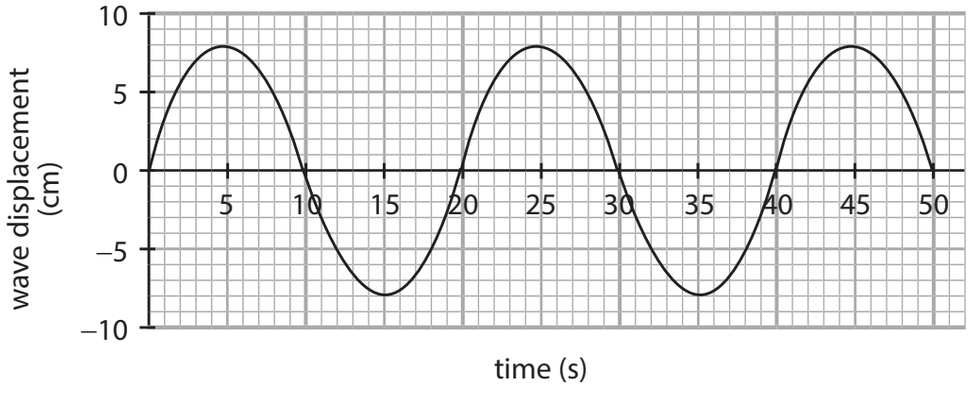

Figure 1

(a) (i) Identify the number of oscillations shown in Figure 1.

(1)

☒ **A** 2

☒ **B** 2½

☒ **C** 3

☒ **D** 3½

(ii) Give the amplitude of the surface water wave shown in Figure 1.

(1)

amplitude = ... cm

(iii) Give the period of the surface water wave shown in Figure 1.

(1)

period = ... s

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(b) The surface water wave is a transverse wave.

Describe how the water molecules move in the wave.

(2)

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(c) The speed (v) of a different surface water wave is 1.5 m s^{-1}.

The frequency (f) of the wave is 2.5 Hz.

Calculate the wavelength (λ) of the wave.

(3)

Use the equation: $v = f \lambda$

Show your working.

wavelength = ... m

(Total for Question 1 = 8 marks)

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2 Diffraction gratings are used to produce emission spectra.

(a) Complete Sentence 1 to describe diffraction.

(1)

Diffraction is the ..... of waves as the waves pass through the small gaps in a diffraction grating.

Sentence 1

(b) The atmosphere of a star contains **two** gases.

Figure 2 shows the emission spectra of four gases, P, Q, R and S, and the emission spectrum of the light from the atmosphere of the star.

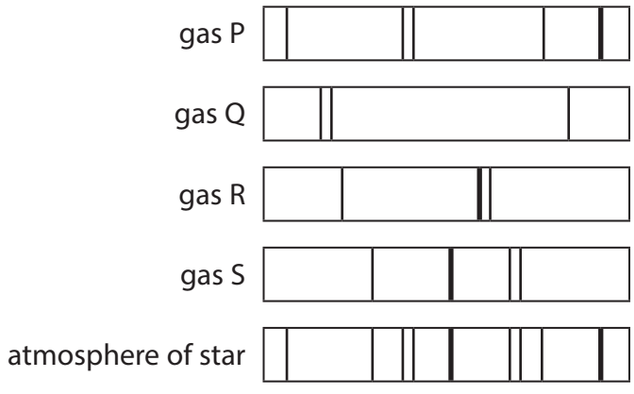

Figure 2

(i) Identify the **two** gases in the atmosphere of the star, using information from Figure 2.

(1)

1 .....

2 .....

(ii) Give **two** reasons for your choices in (b)(i).

(2)

1 .....

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2 .....

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(Total for Question 2 = 4 marks)

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3 Figure 3 shows refraction at an air-glass boundary.

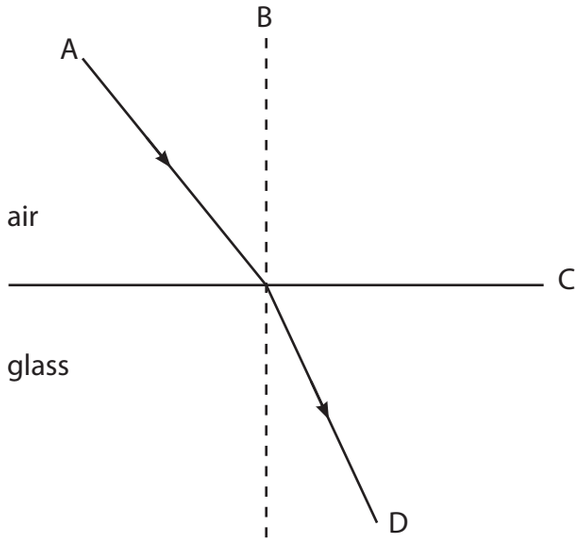

Figure 3

(a) Which line in Figure 3 is the normal?

(1)

- ☒ A
- ☒ B
- ☒ C
- ☒ D

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(b) A different ray of light has an angle of incidence (i) of 48°.

The speed of light in air (c) is $3.0 \times 10^8\,m\,s^{-1}$.

The speed of light in glass (v) is $2.0 \times 10^8\,m\,s^{-1}$.

Calculate the angle of refraction (r) for this ray of light.

(4)

Use the equation:

$$\frac{c}{v} = \frac{\sin i}{\sin r}$$

Show your working.

angle of refraction (r) = ... °

(Total for Question 3 = 5 marks)

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4 Figure 4a shows an analogue signal.

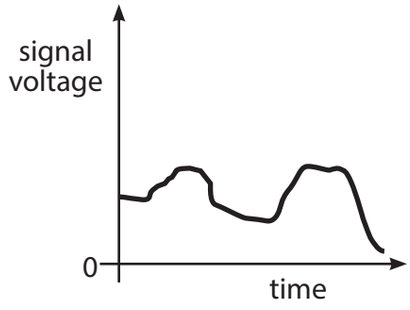

Figure 4a

(a) (i) Describe the analogue signal shown in Figure 4a.

(2)

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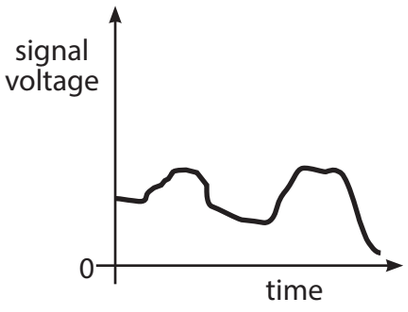
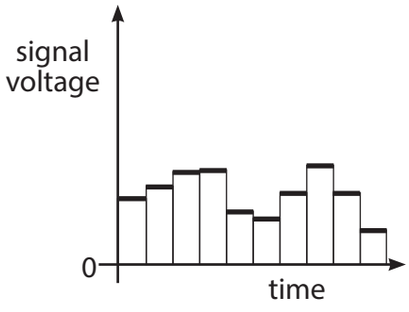
(ii) An analogue-digital converter is used to convert the analogue signal to a digital signal.

The first stage in the conversion process is to sample the signal.



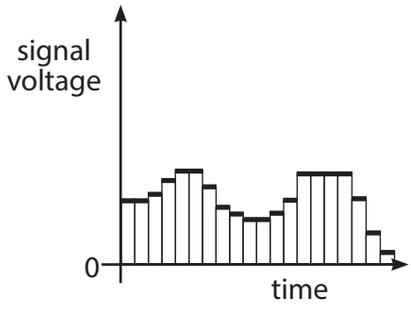
analogue signal

Figure 4a



digital signal
low sampling rate

Figure 4b



digital signal
higher sampling rate

Figure 4c

Figure 4b shows the digital signal produced when using a low sampling rate.

Figure 4c shows the digital signal produced when using a higher sampling rate.

Explain the importance of sampling rate in the conversion of analogue signals to digital signals.

(2)

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(b) Explain **one** advantage of using digital signals rather than analogue signals.

(2)

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(Total for Question 4 = 6 marks)

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5 Waves are used to transmit signals to devices in the home.

(a) Which is the correct statement about Wi-Fi?

(1)

- ☒ **A** Wi-Fi uses the infrared region of the electromagnetic spectrum.
- ☒ **B** Wi-Fi needs 'line of sight'.
- ☒ **C** Wi-Fi can be used to connect multiple devices to the internet.
- ☒ **D** Wi-Fi uses 'frequency hopping'.

(b) Signals can be transmitted to a home using optical fibres or using satellites.

Compare the transmission of signals using optical fibres with the transmission of signals using satellites.

Your answer should include similarities and differences of the:

- method of transmission
- wave frequency.

(6)

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(Total for Question 5 = 7 marks)

TOTAL FOR SECTION C = 30 MARKS
TOTAL FOR EXAM = 90 MARKS

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Formulae sheet

Wave speed $v = f\lambda$

Speed of a transverse wave on a string $v = \sqrt{\frac{T}{\mu}}$

Refractive index $n = \frac{c}{v} = \frac{\sin i}{\sin r}$

Critical angle $\sin C = \frac{1}{n}$

Inverse square law in relation to the intensity of a wave $I = \frac{k}{r^2}$

$$\frac{I_1}{I_2} = \frac{(D_2)^2}{(D_1)^2}$$

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